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(54) Title of the Invention: Active matrix display device

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(72) Inventor Tsuneo Yamazaki
c/o Seiko Instruments Inc.
6-31-1 Kameido, Koto-ku, Tokyo
(71) Applicant Seiko Instruments Inc.
6-31-1 Kameido, Koto-ku, Tokyo
(74) Agent Patent Attorney Tsutomu Mogami

SPECIFICATION

1. TITLE OF THE INVENTION

Active matrix display device

2. SCOPE OF CLAIM

An active matrix display device having a built-in driver circuit made of thin film transistors and provided with switching elements in respective pixels, characterized in that a driver circuit for drain lines is formed of a plurality of, n-pieces, driver circuits which operate in parallel, and each shift register of the above drives drain lines in a

region of a screen that is divided into 1/N.

3. DETAILED DESCRIPTION OF THE INVENTION

[Industrial application field]

This invention relates to an active matrix display device of a liquid crystal, an electrochromic or the like, which incorporates a driver circuit

[Prior Art]

Conventionally, an active matrix liquid crystal display device in which a thin film transistor is provided for every pixel as a switching element on a transparent insulating substrate, as shown by a circuit diagram of FIG. 2, is known. In FIG. 2, an active matrix liquid crystal display device 13 includes an active matrix array 14 formed of thin film transistors. A driver circuit comprises a gate line driver circuit 15 for driving a gate line and a drain line driver circuit 16 for driving a drain line. The drain line driver circuit 16 includes a sample holding circuit 17 and a shift register 18. An image signal for one scanning line is sequentially written into the sample holding circuit 17 by the shift register 18 and is held. The gate line driver circuit 15 sequentially scans gate lines in a vertical direction to write an image signal in each line. A structure of the active matrix array 14 is shown by an equivalent circuit diagram of FIG. 3. Each pixel comprises a thin film transistor 19, an image signal holding capacitor 20 and a liquid crystal cell 21, and is connected to a drain line Yi in a vertical direction and a gate line Xj in a horizontal direction, and is arranged in array. When the gate line Xj is ON, an image signal is written into the image signal holding capacitor 20 through drain lines Yi, Yi + 1 and the like. After the gate line Xj turns OFF, voltage is held, and voltage continues to be applied to the liquid crystal cell 21 until the next image signal is applied. In this manner, since static operation is possible for the liquid crystal cell 21, a display with a high-quality such as high-contrast and wider view angle is possible as compared with a conventional matrix liquid crystal display device.

[Problems to be solved by the Invention]

However, in the conventional active matrix display device, in the case of displaying a TV image with a frame frequency of 60 Hz by using pixels in matrix of height x width = about 240 x 240, for example, a clock frequency of a drain line driver circuit is 1 to 4 MHz. In this condition, an operation speed of a driver circuit realized by thin film transistors is about 100KHz and slow; therefore, it is difficult to provide a driver circuit on the same substrate as an active matrix display device. Because of this, there is a defect that it is necessary to conduct a wire bonding or the like at several hundreds of portions for connecting to an external driver circuit.

Therefore, an object of this invention is to obtain an active matrix display device incorporating a driver circuit, which can be realized by even using a thin film transistor having a slow operation speed, for the sake of solving the defect like this of the conventional one.

[Means for solving the Problems]

In order to solve the above problem, a driver circuit of an image signal is divided into a plurality of, n-pieces, circuits and the divided driver circuits are each operated in parallel simultaneously, according to this invention.

[Operation]

As described above, the clock frequency of a driver circuit is 1/N by dividing a driver circuit, (for example, in the case of a driver circuit requiring a clock frequency of 4MHz, when N = 10, namely, when dividing the driver circuit into 10, a clock frequency of 400 kHz is sufficient), and a driver circuit can be integrated on the same substrate as a switching element, by even using a thin film transistor having a slow operation speed.

[Embodiment]

Hereinafter, the embodiment of this invention is described with reference to figures. In FIG. 1, an active matrix array 2 shown in FIG. 3, formed of thin film transistors, a gate line driver circuit 3 for driving a gate line, three drain line driver circuits 4, 5, and 6 for driving drain lines are formed in an active matrix liquid crystal display device 1. The gate line driver circuit 3 sequentially scans gate lines in a vertical direction in synchronization with G-clock signal. D-clock signals and Vv1, Vv2, and Vv3 of image signals are each added to the drain line driver circuits 4, 5 and 6. The drain line driver circuits 4, 5 and 6 drive each one-third drain lines of one screen. The clock frequency of D-clock signal may be one-third as compared with the case of scanning one scanning line by only one shift register.

An example of an external driver circuit of the active matrix liquid crystal display device 1 includes a shift register 7, a sample holding circuit 8, shift registers 10, 11 and 12 and the like as shown in FIG. 2. An image signal is sequentially written into the sample holding circuit 8 by the shift register 7 and is held. When the next scanning line starts to be scanned, the image signal written in the sample holding circuit 8 is transmitted to a sample holding circuit 9. The image signal held in the sample holding circuit 9 is divided into every one-third of one scanning line by the shift registers 10, 11 and 12 and is written into the drain line driver circuits 4, 5, and 6 in synchronization with D-clock signals. The drain line driver circuits 4, 5, and 6 drive each drain lines in the region of a screen that is divided into three, in parallel simultaneously.

Although the above description shows the case where the drain line driver circuit of the active matrix liquid crystal display device 1 is divided into three, for example, if the division number is ten, the clock frequency becomes more reduced and one-tenth. The increase of the input signal number to the active matrix liquid crystal display device 1 at this time is not so increased as compared with three-division, since D-clock signal is common to all drain line driver circuits, and is at most seven lines by an increase of the image signal lines.

Although the above description shows the case of the active matrix liquid crystal display device using a liquid crystal, the present invention can be applied to an active matrix display device using EL, electrochromic or the like. As the thin film transistor used in the present invention, an insulated gate electric field effect transistor using amorphous silicon, polysilicon, Te or the like as the semiconductor material is typical. In addition, it is obvious that the present invention can be applied to a liquid crystal color display using a color filter as well as a monochrome display as the display system.

[Effect of the Invention]

As described above, this invention has effects of reducing drastically a clock frequency of an image signal driver circuit without increasing drastically the number of input terminals by dividing the image signal driver circuit into plural ones, and realizing an active matrix display device incorporating a driver circuit on the same substrate as the active matrix display device, by even using a thin film transistor having a slow operation speed.

4. BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a circuit diagram of an active matrix liquid crystal display device according to this invention. FIG. 2 is a circuit diagram of a conventional active matrix liquid crystal display device. FIG. 3 is an equivalent circuit diagram of an active matrix array.

1...active matrix liquid crystal display device
2...active matrix array
3...gate line driver circuit
4, 5, 6...drain line driver circuit
Yi, Yi + 1...drain line

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